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ABSTRACT

Through the 10 lessons in this guide, elementary school students can be introduced to the characteristics of air, methods of air pollution control, air movement, and the health effects of polluted air. A directory of field trip sites and a list of teacher resources is included. Contained in each lesson plan are a materials list, general introduction, questions, and activities. The materials can be used in conjunction with studies in health, science, social studies, and government. Suggested follow-up activities include skills developed in art and English classes. (Author/WB)

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CLEAN AIR

for

ANCHORAGE and FAIRBANKS

Curriculum for Grades 1-6

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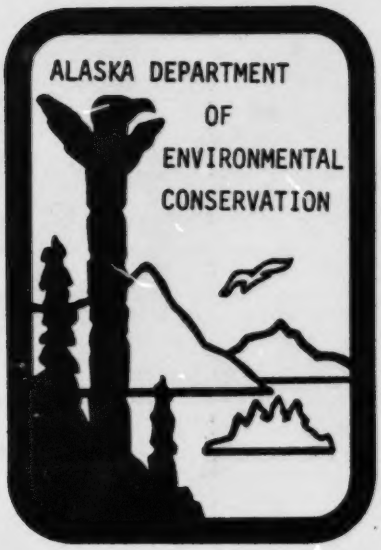
South East Regional Resource Center

Phone 586-6806, 586-6807
538 Willoughby Avenue
Juneau, Alaska 99801



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ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Pouch O

Juneau, Alaska 99811

Jay S. Hammond
Governor

Ernst W. Mueller
Commissioner

Juneau

February 1980

AIR QUALITY

GRADES 1-3

STATE OF ALASKA

DEPT. OF ENVIRONMENTAL CONSERVATION

JAY S. HAMMOND, GOVERNOR

POUCH O – JUNEAU 99811

January 29, 1980

Dear Alaskan Educator:

The carbon monoxide and ice fog problems in Anchorage and Fairbanks present serious health threats to local residents. These problems are the result primarily of dramatic topographical and meterological conditions, combined with a dense population, a large enormous winter energy consumption, and the inefficient operation of automobiles in cold weather.

Some of the solutions, such as transportation planning and new technology, have a minimum impact upon people's day-to-day activities. But other solutions, such as use of mass transit and engine heaters, car pooling, keeping one's car properly tuned, driving less, or even giving up a vehicle, are solutions which often require additional expenses and even changes in lifestyle and attitudes. Behavior that causes environmental problems may often be hard to change due to personal attitudes and value systems.

These values and attitudes are developed at an early age, and we have designed this curriculum to help you provide future decision-makers with the knowledge of man's interrelationship with the environment and the ability to effect change. It is our hope that our children will be more knowledgeable, skilled, and motivated to demand cleaner air, to make responsible decisions concerning air quality, and to accept the resulting changes to their lives.

This curriculum is multi-disciplinary and can be approached from any of the following subject areas with little adaptation: health, science, social sciences, and government. The suggested activities include skills developed in art, English, drama, and library classes. It could be used very effectively when coordinated between classes taught in several subject areas.

We hope you find this material to be very useful in helping your students meet your own learning objectives, and at the same time learn about causes and solutions to one of Alaska's significant environmental problems.

Sincerely,

Ernst W. Mueller
Commissioner

Air Quality

Introduction:

Five lessons are used to introduce the students to clean air and air pollution, and to develop an awareness in the students of ways to help limit the amount of air pollution in their community.

Lesson one is divided into two parts. The first introduces the concept that air is a substance, therefore it occupies space. A dramatization of this concept shows why air, in an inverted glass keeps water from entering, and why air in a balloon pushes the water out of a container. The second part recognizes the existence of oxygen in the air and explains how oxygen is essential to life. An experiment with a glass jar over a candle demonstrates this lesson.

The second lesson extends the air concept to include other elements seen as particles unessential and possibly hazardous to life. In separate experiments a car's gaseous emissions are used on a plant, and a vacuum is used with coffee filters to give a dramatic example of unseen particles in the air.

The intent of the third lesson is to inform the students of some of the physical dangers to human beings associated with air pollution. A chart and a diagram are used to help the students grasp this information.

The intent of lesson four is to prepare in younger students an awareness of visible differences of the air in their environment. Each student is given a "before and after" picture of the same city to be colored to show air pollution and no air pollution.

Lesson five introduces a variety of possibilities which students and their families can do to limit the amount of air pollution in their community. This lesson ties in directly with solutions for the problems to which the students have been introduced.

Flexibility is a prime goal in the use of these lessons. The lessons may be taught in any order depending on the needs of the students and the availability of resources.

TEACHER RESOURCE LIST

The resources listed below can be found in the Alaska State Library system.

Adler, Irving, The Environment, 1976 (J 574.5 ADLE)

Borsoff, Norman, Don't Give Up, 1972 (J)

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Hyde, Margaret Oldroyd, For Pollution Fighters Only, 1971 (J 628.5 HYDE)

McCoy, Joseph J., Shadows Over the Land, 1970 (J 628.5 MCCO)

Meyer, Louis A., The Clean Air and Peaceful Contentment Dirigible Airline, 1972 (J)

Peet, Bill, The Wump World, 1970 (J)

Pomerantz, Charlotte, The Day They Parachuted Cats on Borneo: A Drama of Ecology, 1971 (J 574.509 POME)

Field Trips and Community Information Sources

The following list of agencies, businesses, and places in Anchorage and Fairbanks have been collected for the purpose of planning field trips or "tapping" knowledgeable community resources. Activities planned to involve these resources may provide a way for the student to more easily understand how air pollution actually affects human life.

Anchorage

1) Air Pollution Control Agency
   825 L. Street
   Anchorage, AK 99501
   (This agency monitors air pollution in the Anchorage area. They can demonstrate how this is accomplished and provide detailed information on air quality in the city.)

2) Arctic Environmental Information and Data Center
   707 A. Street
   Anchorage, AK 99501
   (This is a research organization funded by the state of Alaska. It may be possible to arrange for a speaker on a topic of interest to your class.)

3) Alaska Department of Environmental Conservation
   338 Denali St., MacKay Building, Room 1206
   Anchorage, AK 99501
   (This office has a small staff. There is a possibility of arranging a speaker on the topic of pollution control.)

4) Vern's Asphalt Maintenance
   Box 41319
   Anchorage, AK 99509
   (This business operates large road equipment which cleans dust and oil from the roads in Anchorage. Ambient particulate pollution is one of Anchorage's major air quality problems. This business can demonstrate how that problem can affect city life.)

5) Auto Shops
   contact through yellow pages
   (Auto shops may provide information and a demonstration of how catalytic convertors and pollution control valves reduce polluting emissions from car engines.)

6) Asphalt Products Industries
contact through yellow pages
(All asphalt industries have been made to install pollution control devices. An explanation of how they control air pollution may be available from one of the local businesses.)

7) Tall Buildings
(High places such as tall buildings in Anchorage provide views of dust pollution and of weather inversions during the winter months.)

Fairbanks

1) Fairbanks North Star Borough
Environmental Services
P.O. Box 1267
Fairbanks, AK 99707
Contact person: Heather Stockard
(The Department of Environmental Services monitors and analyzes daily pollution information in its downtown location. Groups of students are welcome to view the facilities and will be given a guided tour by a person knowledgeable about air pollution. Speakers can also be arranged from this organization.)

2) Washington Alaska Montana Idaho (WAMI)
Medical Education Program, Univ. of Alaska, Fairbanks
479-7731
(This organization has previously done research about the health effects of air pollution. WAMI is a program within the University of Alaska and may be able to assist in special tours or speakers for older students.)

3) North Pole Refinery
P.O. Box 5028
North Pole, AK 99705
(The North Pole Refinery has previously provided tours for students. A field trip to this refinery will provide an opportunity to see how industry can control its pollution emissions through application of pollution control technology.

4) Municipal Utilities System
P.O. Box 60280
Fairbanks, Alaska 99707
(Students can witness a major pollution source and see how people have developed technology to control the pollution emissions given off in the production of electrical

energy. Other generating plants in the Fairbanks area are: University of Alaska and Fort Wainwright's power plants, and the Golden Valley Diesel Generating Plant.)

5) Alaska Department of Environmental Conservation
Northern Region Office, P.O. Box 1601, Fairbanks, AK 99707
phone: 452-1714
(Speakers are available. Personnel from this office can discuss problems general to Alaska as well as specific problems concerning the air quality in Fairbanks.)

6) During the winter months "ice fog" can be physically witnessed in several places in Fairbanks. It is particularly thick on the Richardson Highway near Fort Wainwright.

Tall buildings in Fairbanks may offer a unique vantage point to view the ice fog phenomena.

7) Fairbanks Environmental Center
218 Driveway
Fairbanks, AK 99701
(Information and speakers may be available from the organization.)

Lesson I — Characteristics of Air

Objective 1: Students will be able to explain, to the satisfaction of the teacher, in graphic or verbal form, the concept "air occupies space".

Materials:
1 small glass
2 kleenexes
1 deflated balloon
1 large see-through container (an aquarium, bowl or large jar)
enough water to cover the glass

Introduction: We do not often think about the air through which we move because we pass through it so easily. However, air is a substance which occupies space. Because air takes up space it has the potential of pushing other substances out of the way. This fact helps explain why the air in an inverted glass keeps water from entering it, and why the air in a balloon pushes the water out of a container.

Instructional Activities:

(first experiment)

1. A) Ask the students if a kleenex will become wet if it is pushed under the water. Do so to demonstrate that it will become wet.

   B) Ask the students if a kleenex will become wet if it is placed in a jar, turned upside down and submerged. Do so after the children have made their responses.

   Ask questions about the outcome such as: is the kleenex wet, what prevented the kleenex from becoming wet?

   C) Repeat the experiment tilting the glass sideways. Observe the escaping air. Ask the students to explain what has happened.

(second experiment)

2. A) Ask the students if a balloon will affect the water level. Push a deflated balloon just under the water in the container.

B) Ask the students if a balloon full of air will affect the water level. Blow up the balloon and force the blown-up balloon under the water so that it is all submerged.

C) Ask the students to explain what has happened in terms of the observed change in water levels.

Objective 2: Students will be able to identify, to the safisfaction of the teacher in graphic or verbal form, oxygen as being an element of air.

Materials: 2 small candles
1 clear glass jar
matches

Introduction: Building on the previous objective, students are now presented with an experiment demonstrating the existence of oxygen in air. The importance of oxygen is significant in relation to the understanding of air pollution. To help the students realize the objective of the lesson point out that the same oxygen essential to life is necessary for fire. Life and fire are both impossible in the absence of oxygen.

Instructional Activities:

1. A) Place two lighted candles in plain view of the group. Ask the students what will happen if a jar is placed over one. Do so after the children have made their responses.

   Ask, "Why did the candle under the jar go out while the other remained flaming?"

   B) Repeat the experiment.

   C) Discuss the results in relation to the objective.

Lesson II Two Air Pollutants

Objective 1: Students will be able to list or recite two air pollutants contained in automobile exhaust.

Materials:
1 tank vacuum cleaner
1 rubber band
2 coffee filters
1 potted plant
1 automobile
1 glass container large enough to fit over the potted plant
1 Student Response sheet: "Follow the Pollutant..." (pg. 12)
1 Student Response sheet: "Color the Path of Exhaust Black" (pg. 13)

Introduction: This unit builds on the previous unit by extending the concept of air to include elements other than oxygen. Awareness of particles unessential and possibly hazardous to life are now introduced.

The particulate matter which will be seen in the vacuum collection activity are "small" pieces of unburned carbon. The finer the particles produced by fuel combustion in cars, the more likely they are to reach the innermost parts of the lungs where they cause the most damage. The larger type of particulate matter is of minor concern compared to the overall problem of air pollution. It is, however, easier for children to see, and its usefulness is in providing a concrete reference to the general topic of the car's contribution to the problem of air pollution.

Teaching about gaseous emissions from cars is complicated by the fact that the gas is invisible. Depending on the background and past learning experiences of the group, the concept of gas may have to be introduced or reviewed.

There are three types of gaseous emissions produced by cars: carbon monoxide, nitrogen oxide and hydrocarbons. Carbon monoxide was chosen to focus upon because it is the air pollutant which currently represents the major health threat to Anchorage and Fairbanks residents. It is significant to the overall problem of air pollution because it accounts for more the 51% of the total annual air pollutant emissions in North America. This gas is almost entirely a human-caused pollutant. The

most significant source is incomplete combustion, during which each carbon atom combines with only one atom of oxygen. Estimates show that automobile engines alone contribute more than 80% of the global carbon monoxide emissions. (Andrews, William A. A Guide to the Study of Environmental Pollution, Prentice Hall, Inc. 1972.)

Vocabulary Preparation:

Particulate	particle
exhaust	pollutant
oxygen	engine
pollution	

Instructional Activities:

(first activity)

A) Cut a piece of filter paper a little bigger than the end of the vacuum hose. Fold it down and put the rubber band over the filter to hold it in place.

B) Use this "pollutant collector" to collect the exhaust coming from an automobile. In doing this project be careful to stand to one side of the car so you will not breathe the carbon monoxide.

C) After you have a good sample discuss with the children the results of the collection. Use the sample to develop the concept of pollution as particles in the air which are unessential and hazardous to life.

D) Ask, "Will the particles coming out of the exhaust become part of the air? Is it possible that people could breathe these particles into their bodies?"

E) Building on ideas introduced in the last unit which stress the importance of oxygen to life, discuss with the children whether it would be good or bad to breathe these particles into one's body.

(second activity)

1. A) Using a potted plant (perhaps a broad-leaved weed transplanted for this purpose) review or introduce the fact that the plant needs oxygen to live.

B) Place the glass container over an exhaust pipe of a car to capture the car's emissions. Put the container over the potted plant. Use a piece of wood as a base to set the plant and

jar on to stop the gas from leaking so that the plant can be moved to the classroom for observation.

C) The space in the jar is filled with a limited amount of oxygen and a large amount of exhaust fumes. The plant leaves will drop slowly during the course of the day.

D) Ask the students to explain what has happened in terms of how the gas, captured from the car's engine, has affected the plant.

E) Ask the students to identify the two pollutants found in the exhaust of an automobile.

Additional Activities:

1. Two student response sheets have been included for possible use as reinforcement activities.

2. In winter a short walk can be taken to observe particulate matter from cars - it's on the snow next to roads. Not all of that "dirt" is from the ground or road surface.

FOLLOW THE

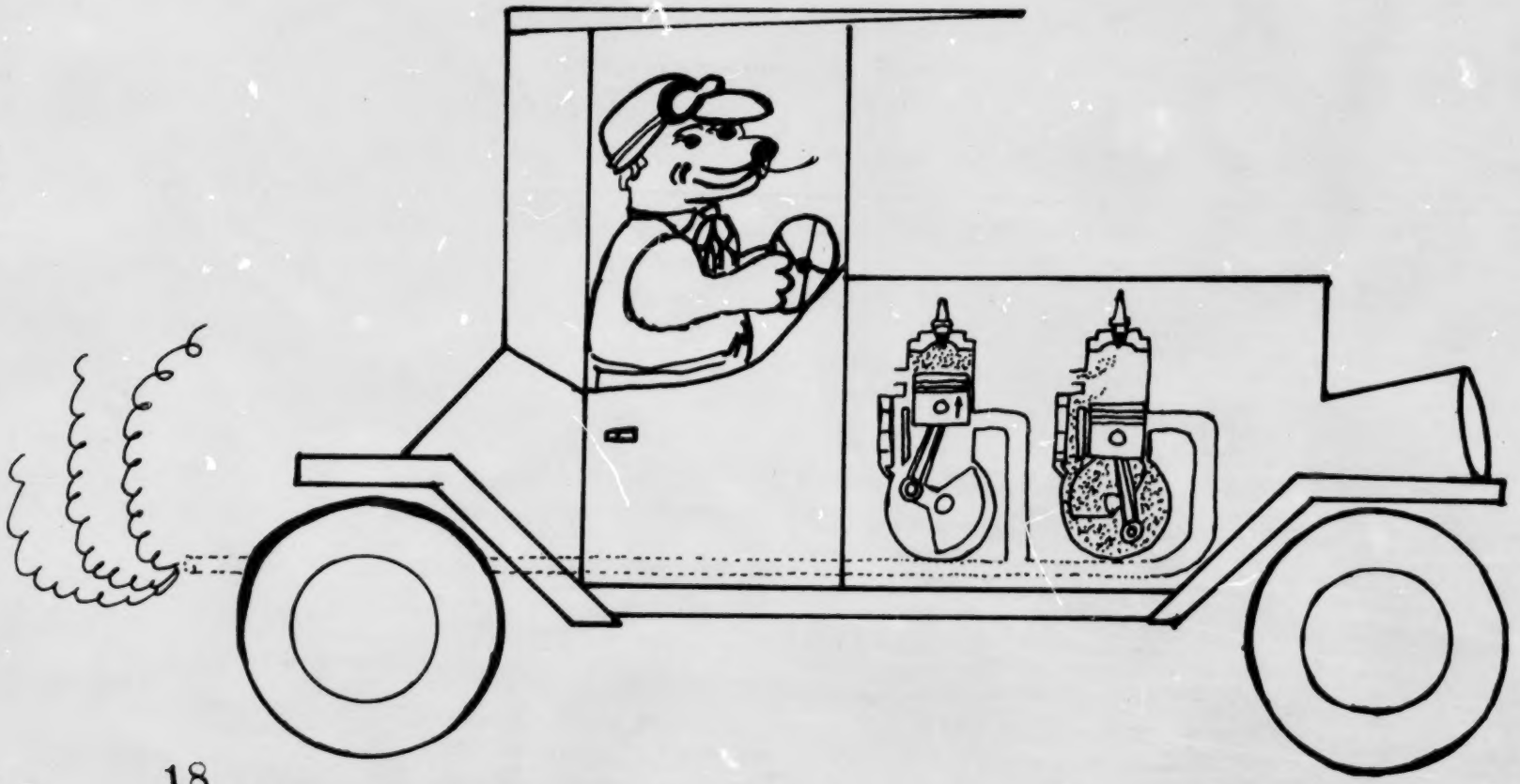
POLLUTANT

INTO

YOUR

LUNGS

COLOR THE PATH OF EXHAUST BLACK



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Lesson III Health Effects of Air Pollution

Objective: Students will be able to indicate on a diagram the area of the human body adversely affected by air pollution.

Materials: 1 Student Response sheet: "How Air Pollution Might Affect You" (pg. 16)

Introduction: The students have been presented with a real experience involving the existance of two pollutants. This topic is more abstract in that it deals with information which the students may not have experienced. The intent of this lesson is to inform the student of some of the physical dangers to human beings associated with air pollution.

Vocabulary Preparation: review all previous words

gas	disease
carbon monoxide	dizzy
lung	

Instructional Activities:

1) Draw the following table on the chalk board.

Pollutant	Health Effects
Carbon Monoxide	
Particulates	

2) Review with the class what they learned about carbon monoxide in the last lesson.

3) Inform the students about the health effects of carbon monoxide. In large amounts it can kill and smaller amounts can cause dizziness and headaches. Write dizziness and headaches in the appropriate box.

4) Review with the class what they learned about particles of pollution in the last lesson. Depending on the class it may be useful to develop the concept of particulates to include dust and smoke also.

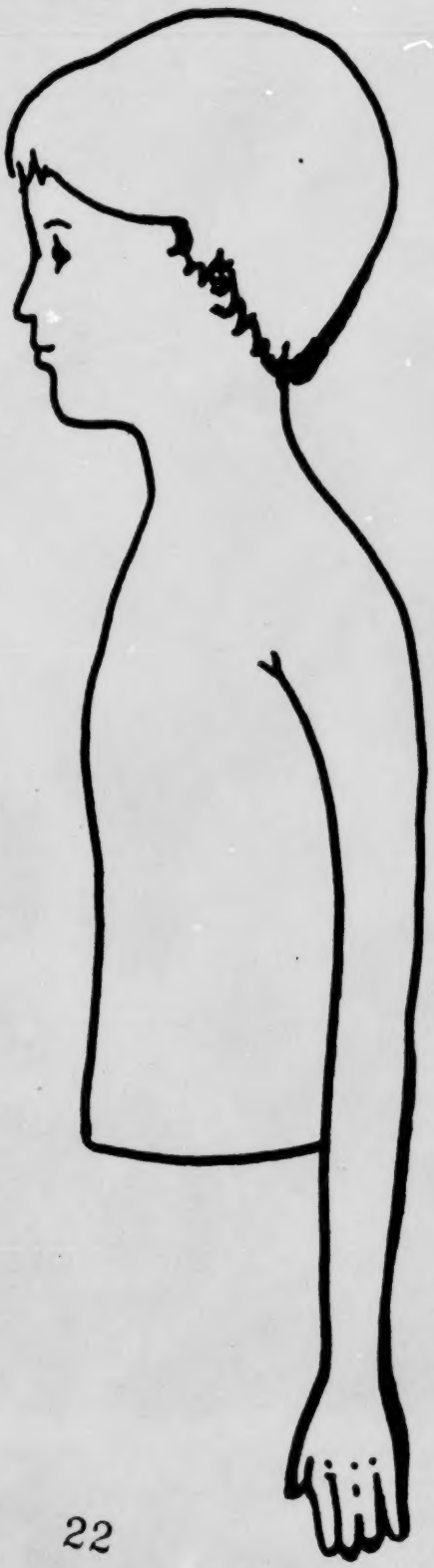
Lesson III — Health Effects of Air Pollution (con't)

5) Inform the students that the particles in the air carry poisonous gases to the lungs and create a danger of lung disease. Write lung disease in the appropriate box.

6) Pass out student response sheet and ask the students to write the three health effects on three lines. Direct the students to draw lines from the names to the parts of the body which would be affected by air pollution.

Additional Activities: Invite a person such as a health worker, a doctor or a pollution control worker to speak to the class concerning the adverse health effects of air pollution.

How air pollution might affect you.



Lesson IV — Visible Signs of Air Pollution

Objective: Students will be able to differentiate between symbolic aspects of a city scene depicting air pollution and a second city scene depicting a clean atmospheric environment.

Materials: 1 Student Response sheet: "Our City" (pg. 19)

Introduction: Alaska's major air pollution problem concerns transportation-related activities in which the automobile plays a major role. Air pollution is usually visibly recognizable and students can be taught to distinguish between signs of air quality that are conducive to good health and signs of poor air quality. It is the intent of this lesson to prepare younger students to be aware of visible differences of the air in their environment.

Vocabulary Preparation: review all previous vocabulary

air pollution exhaust

Instructional Activities:

1. Ask the students to describe what air pollution looks like. Who in the class has had a direct experience with air pollution which they can relate?

2. Building on Lesson II, ask the students, "What are two pollutants which come from a car engine? Can you see the pollutants? Can you smell the pollutants?"

3. Distribute the response sheets and explain that these pictures are of the same city. The before picture represents the city before it cleaned up its air pollution problems. The after picture represents the city after it cleaned up its air pollution problems.

4. Ask, "In which city scene would you see air pollution? How would you color air pollution in the before scene?"

5. Ask, " In which city scene would you find happier and healthier people? How would you make the people look to show that they are happier breathing clean air?"

Lesson IV Visible Signs of Air Pollution (con't)

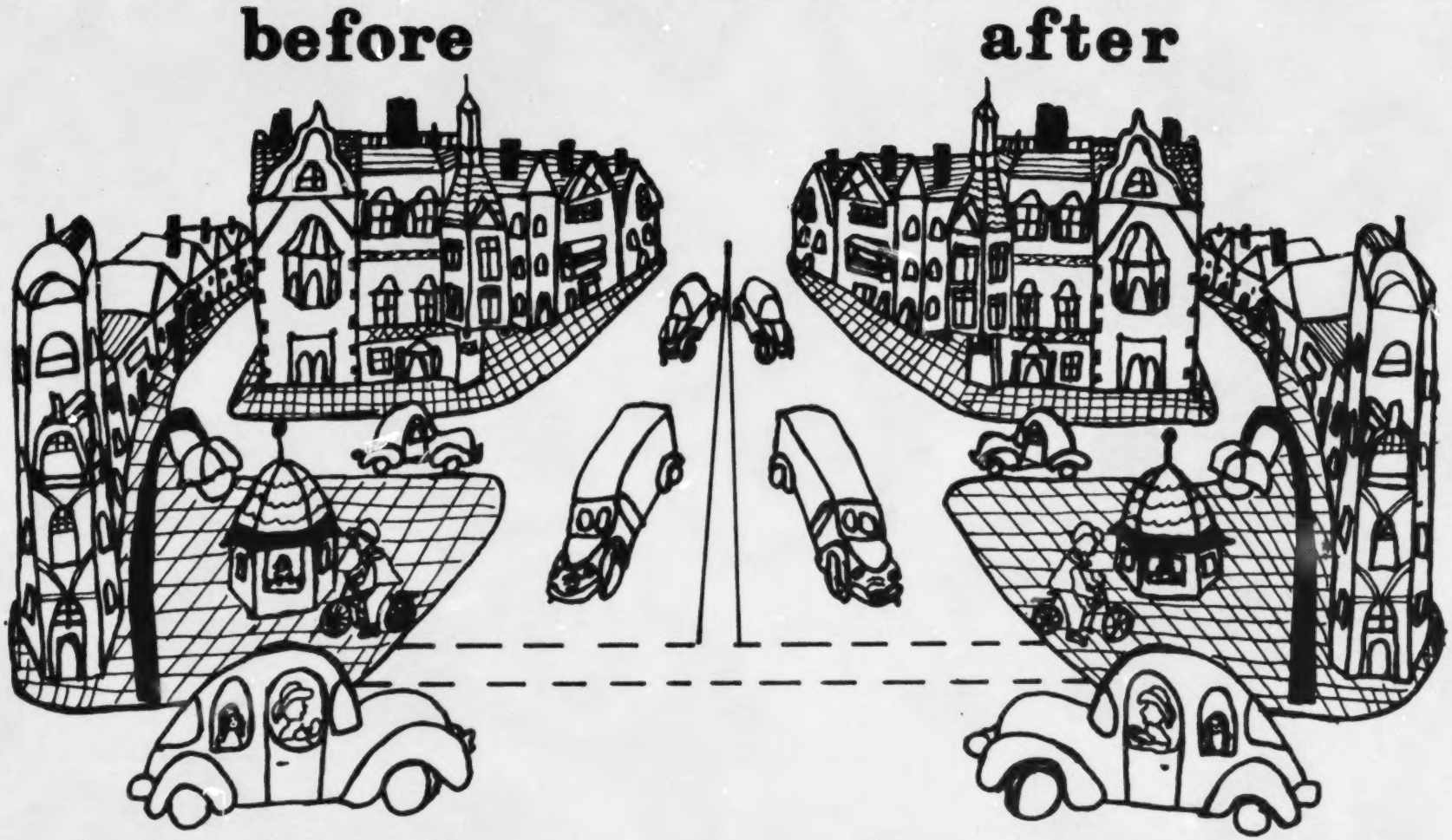
6. Ask, "In which city scene would you be able to see the sun more clearly?"

7. Ask, "In which city scene would you see and smell car exhaust? How will you color exhaust coming from cars in the before scene?"

8. Have the students color the pictures to show the differences of air quality.

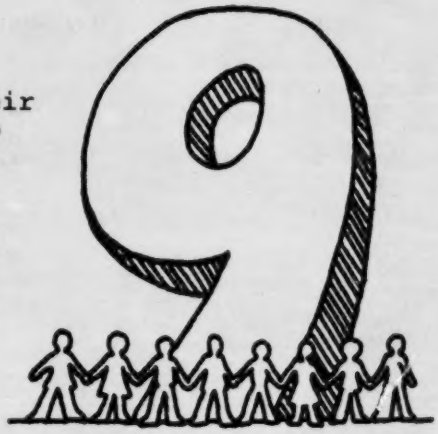
Additional Activities: Make a bulletin board display showing aspects of air quality before and after a city has improved its air quality. Use student input to develop symbols of clean and polluted air.

OUR CITY



air pollution smiles sun exhaust

Lesson V — Personal Involvement



Objective: Students will be able to identify at least three actions which they or their families can take to help reduce air pollution in their city.

Materials: 1 Student Response sheet: "9 Ways People Can Stop Pollution" (pg. 22)

Introduction: This lesson introduces a variety of possibilities which students and their families can do to limit the amount of air pollution in their community. It may seem unrealistic to young students to take responsibility for dealing with a large and many-faceted problem such as air pollution. However, this aspect of life does affect them and they may one day have a role to play in maintaining a healthy environment. The information presented here is intended to develop an awareness of a variety of solutions for the problem to which the students have been introduced.

Instructional Activities:

1. Review with the students what they have learned. Expand the concept, depending on the ability of the group, to include other types of easily recognizable pollutants such as smoke and dust.

2. Ask, "What are the pollutants which we have studied about which dirty the air we breathe? Can you think of other things which might dirty the air?"

3. Ask, "How do you think air pollution is caused? What do people do which causes the air to become polluted?"

4. Draw a nine squared grid on the chalk board. Tell the students that in each square you will write a suggestion for how they think that they or their family could help reduce air pollution.

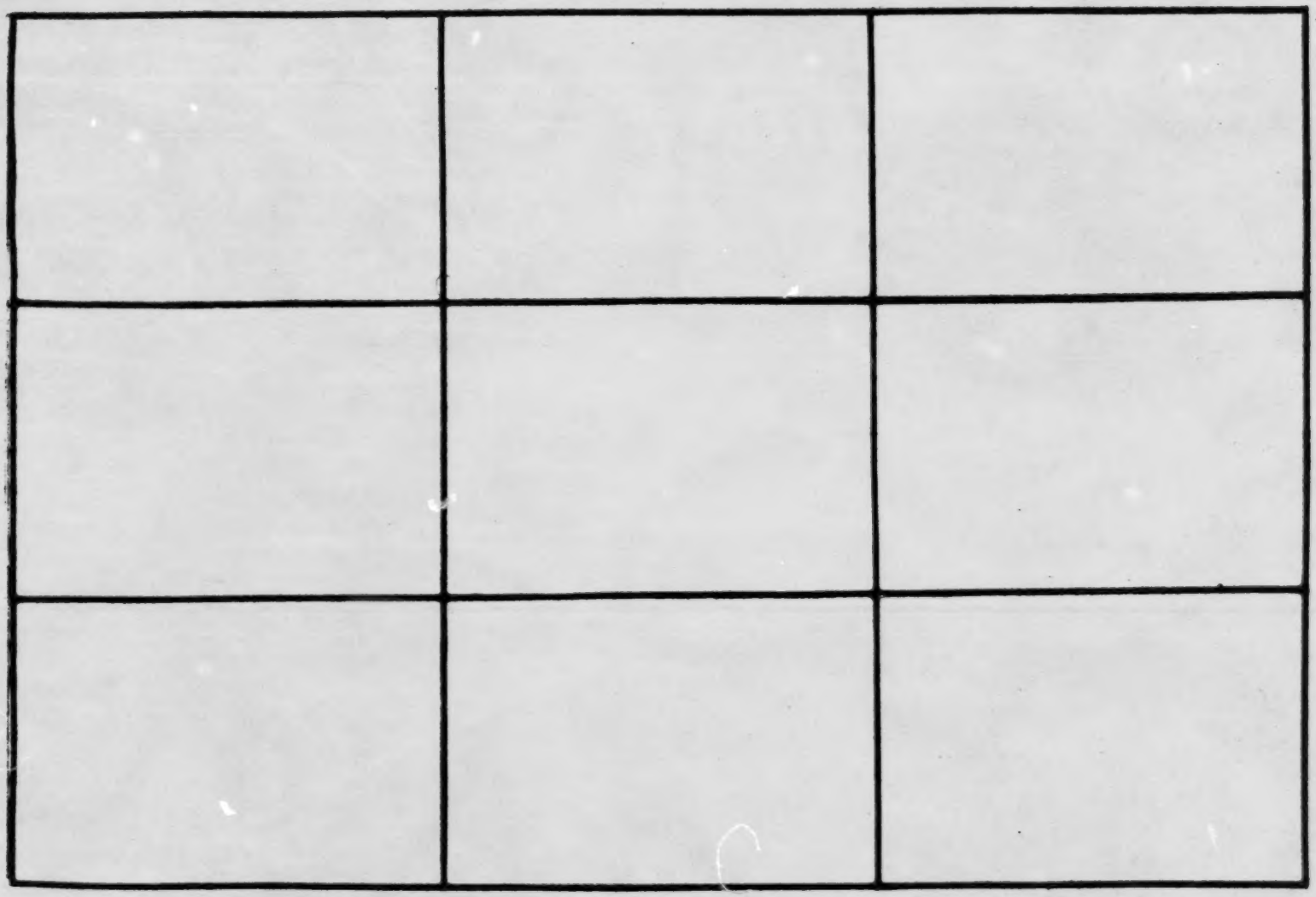
5. Ask, "What kinds of things can you and your family do to reduce air pollution?" Some starters are: walk short distances instead of

driving, stop smoking, bury garbage, don't burn rubbish, check car, ask government for help, etc.

6) Distribute the response sheet of the nine blank squares. Direct the students to copy the solutions to the pollution problem and circle the ones which they feel that they or their families can do.

7) Have the students take their response sheets home to share with their parents.

9 ways people can stop pollution



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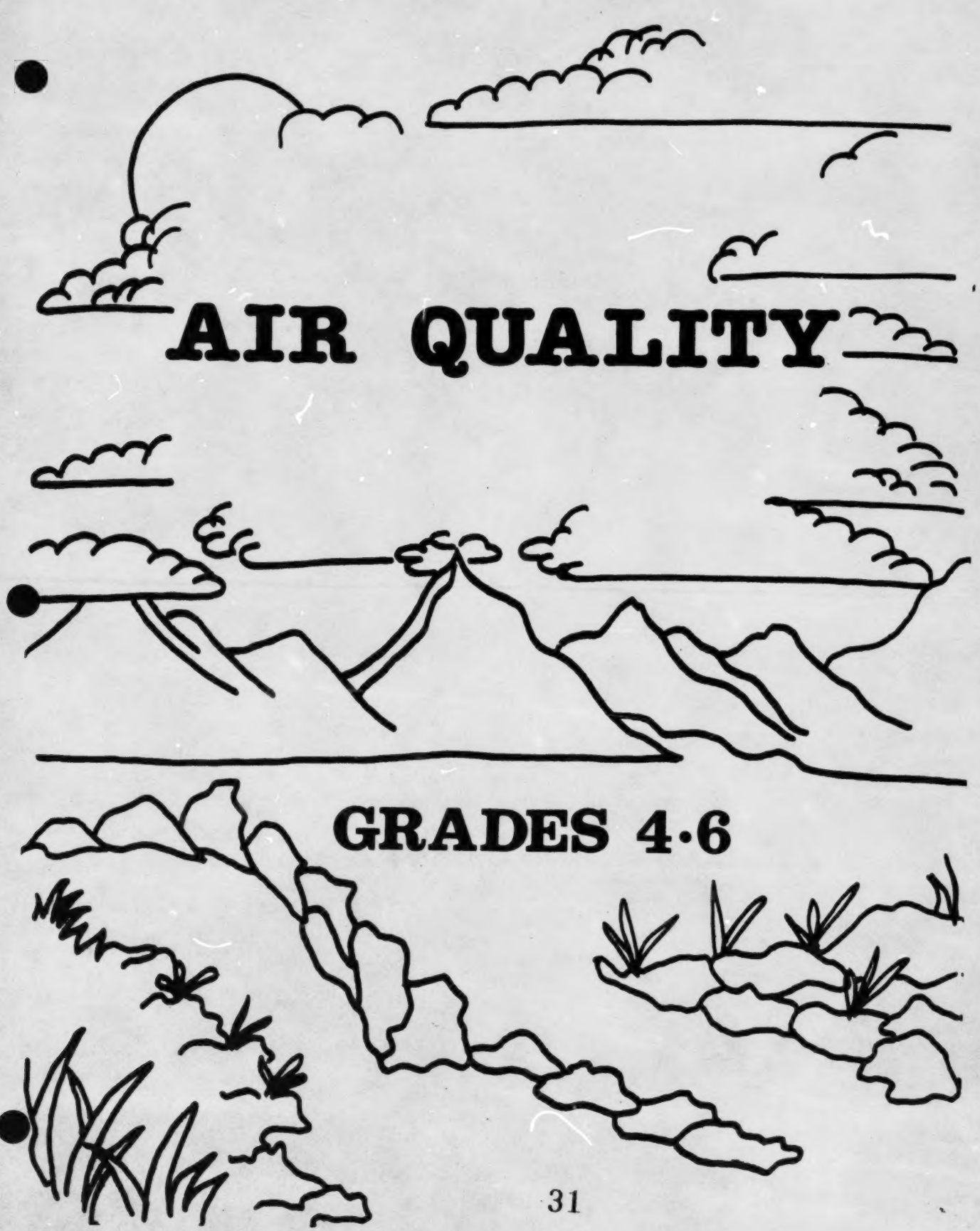

AIR QUALITY

GRADES 4-6

STATE OF ALASKA
DEPT. OF ENVIRONMENTAL CONSERVATION

JAY S. HAMMOND, GOVERNOR

POUCH O – JUNEAU 99811

January 29, 1980

Dear Alaskan Educator:

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These values and attitudes are developed at an early age, and we have designed this curriculum to help you provide future decision-makers with the knowledge of man's interrelationship with the environment and the ability to effect change. It is our hope that our children will be more knowledgeable, skilled, and motivated to demand cleaner air, to make responsible decisions concerning air quality, and to accept the resulting changes to their lives.

This curriculum is multi-disciplinary and can be approached from any of the following subject areas with little adaptation: health, science, social sciences, and government. The suggested activities include skills developed in art, English, drama, and library classes. It could be used very effectively when coordinated between classes taught in several subject areas.

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Sincerely,

Ernst W. Mueller
Commissioner

AIR QUALITY

Introduction:

The following five lessons introduce the student to air. How heat affects air, types of air pollution, how weather conditions affect air pollution, the health hazards of air pollution and how to reduce air pollution are all found in the lessons.

Lesson one involves the concept of air movement, as it is an important factor in understanding air pollution problems in Alaska. A piece of heavy paper is cut into a spiral, then placed above a heat source. The heat will cause increased molecular movement in the air which will cause the spiral to rotate.

Lesson two asks the student to discriminate between particulate and gaseous forms of air pollution. Samples of automobile exhaust can be simply collected and used to show two types of air pollutants emitted from a standard combustion engine.

Lesson three is divided into two objectives. 1) Students will collect samples of dust and produce a hypothesis of how the dust originated, 2) students will read and discuss materials covering the major health effects associated with carbon monoxide and particulate matter. The material is intended to link the pollutants discussed in Lesson II with real live dangers to human health.

The fourth lesson uses a visual aid transparency, reading materials and group discussion to introduce weather conditions that affect air pollution. Specific attention is given to weather inversions and the serious effect they can have on a large Alaskan community in the winter.

Lesson five introduces a variety of possibilities which students and their families can do to limit the amount of air pollution in their community. This lesson ties in directly with solutions for the problems to which the students have been introduced.

Flexibility is a prime goal in the use of these lessons. The lessons may be taught in any order depending on the needs of the students and the availability of resources.

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Hoff, Sydney, Amy's Dinosaur, 1974 (J)

Hyde, Margaret Oldroyd, For Pollution Fighters Only, 1971 (J 628.5 HYDE)

McCoy, Joseph J., Shadows Over the Land, 1970 (J 628.5 MCCO)

Meyer, Louis A., The Clean Air and Peaceful Contentment Dirigible Airline, 1972 (J)

Peet, Bill, The Wump World, 1970 (J)

Pomerantz, Charlotte, The Day They Parachuted Cats on Borneo: A Drama of Ecology, 1971 (J 574.509 POME)

Field Trips and Community Information Sources

The following list of agencies, businesses, and places in Anchorage and Fairbanks have been collected for the purpose of planning field trips or "tapping" knowledgeable community resources. Activities planned to involve these resources may provide a way for the student to more easily understand how air pollution actually affects human life.

Anchorage

1) Air Pollution Control Agency
   825 L. Street
   Anchorage, AK 99501
   (This agency monitors air pollution in the Anchorage area. They can demonstrate how this is accomplished and provide detailed information on air quality in the city.)

2) Arctic Environmental Information and Data Center
   707 A. Street
   Anchorage, AK 99501
   (This is a research organization funded by the state of Alaska. It may be possible to arrange for a speaker on a topic of interest to your class.)

3) Alaska Department of Environmental Conservation
   338 Denali St., MacKay Building, Room 1206
   Anchorage, AK 99501
   (This office has a small staff. There is a possibility of arranging a speaker on the topic of pollution control.)

4) Vern's Asphalt Maintenance
   Box 41319
   Anchorage, AK 99509
   (This business operates large road equipment which cleans dust and oil from the roads in Anchorage. Ambient particulate pollution is one of Anchorage's major air quality problems. This business can demonstrate how that problem can affect city life.)

5) Auto Shops
   contact through yellow pages
   (Auto shops may provide information and demonstration of how catalytic convertors and pollution control valves reduce polluting emissions from car engines.)

6) Asphalt Products Industries
contact through yellow pages
(All asphalt industries have been made to install pollution control devices. An explanation of how they control air pollution may be available from one of the local businesses.)

7) Tall Buildings
(High places such as tall buildings in Anchorage provide views of dust pollution and of weather inversions during the winter months.)

Fairbanks

1) Fairbanks North Star Borough
Environmental Services
P.O. Box 1267
Fairbanks, AK 99707
Contact person: Heather Stockard
(The Department of Environmental Services monitors and analyzes daily pollution information in its downtown location. Groups of students are welcome to view the facilities and will be given a guided tour by a person knowledgeable about air pollution. Speakers can also be arranged from this organization.)

2) Washington Alaska Montana Idaho (WAMI)
Medical Education Program, Univ. of AK, Fairbanks
479-7731
(This organization has previously done research about the health effects of air pollution. WAMI is a program within the University of Alaska and may be able to assist in special tours or speakers for older students.)

3) North Pole Refinery
P.O. Box 5028
North Pole, AK 99705
(The North Pole Refinery has previously provided tours for students. A field trip to this refinery will provide an opportunity to see how industry can control its pollution emissions through application of pollution control technology.

4) Municipal Utilities System
P.O. Box 60280
Fairbanks, Alaska 99707
(Students can witness a major pollution source and see how people have developed technology to control the pollution emissions given off in the production of electrical

energy. Other generating plants in the Fairbanks area are: University of Alaska and Fort Wainwright's power plants, and the Golden Valley Diesel Generating Plant.)

5) Alaska Department of Environmental Conservation
Northern Region Office, Box 1601, Fairbanks, AK 99707
phone: 452-1714
(Speakers are available. Personnel from this office can discuss problems general to Alaska as well as specific problems concerning the air quality in Fairbanks.)

6) During the winter months "ice fog" can be physically witnessed in several places in Fairbanks. It is particularly thick on the Richardson Highway near Fort Wainwright.

Tall buildings in Fairbanks may offer a unique vantage point to view the ice fog phenomena.

7) Fairbanks Environmental Center
218 Driveway
Fairbanks, AK 99701
(Information and speakers may be available from the organization.)

Lesson I — Characteristics of Air Movement

Objective 1: Students will be able to state in oral or written form, to the satisfaction of the teacher, how air movement is affected by heat.

Materials:
- 1 table lamp
- 1 square piece of heavy paper
- 24 inches of thread
- 1 small pot
- 1 candle
- 1 hotplate
- 1 student information sheet: How Air Circulates (pp. 31-32)

Introduction: The following experiment demonstrates how heat affects air movement. It is assumed that students, at this level, will already be familiar with important component parts of air, such as oxygen, carbon dioxide, and water vapor. It is also assumed that students in upper elementary grades have an understanding of the concept of gas and the dependence of life on the availability of oxygen in the air. If the students have not learned these concepts it may be necessary to prepare them for this lesson by providing basic information on the subject of air (see material for grades 1-3).

The concept of air movement is an important factor in understanding air pollution problems in Alaska. Developing a familiarity with how air moves under normal conditions can later be contrasted with atmospheric conditions which create dangerous levels of air pollution in Anchorage and Fairbanks, as presented in Lesson IV.

Vocabulary Preparation:

atmosphere	surface
weather condition	circulate
air pollution	

Instructional Activities: If the students already have some understanding of the term "air pollution", this word can be used in the following question to begin the activity. If the term is unfamiliar then the word "smoke" can be used. The students should be prepared to discuss how substances labeled as pollutants can be carried by the air from one place to another.

1. A) Ask, "How can air pollution from the other side of town be smelled in the school yard?"

   Students should be directed to think of the wind as the mover of substances through the air.

   B) Ask, "Do you know what causes the wind?"

   C) Precut the square piece of heavy paper into a spiral. Punch a small hole in the center. Secure the piece of thread to it by pushing it through the small hole in the spiral and tying a knot to it.

   D) Hold the spiral above - a hotplate, a candle, a pot of cold water, a pot of boiling water, and an electric lamp. Have the students observe the the effect of heat on the air.

   The heat source will cause increased molecular movement in the air which will cause the spiral to rotate.

   E) Ask, "How can you explain what is happening? What causes the air to move?"

2. A) Using the same heat sources as in activity one, the next activity will demonstrate visually how particles are carried into the air and dispersed.

   B) Clap two chalkboard erasers together and observe the dust cloud. Repeat this over each of the heat sources to show the effect that heat has on moving particles upward and outward.

   C) Ask, "How can you explain what is happening? What caused the particles to move? Can someone create a theory of how the wind is formed from what you have seen in the two activities?"

   D) Distribute the reading material, How Air Circulates. Discuss the information in terms of the activities the students have just seen.

   E) Ask the students to explain how air movement is affected by heat.

How Air Circulates

Electric heaters are sometimes used to make rooms warm. Here is how they work. The hot wires of the heater heat the air around them. But when air is made hot it gets lighter than the rest of the air near it. So the lighter, warmer air around the heater wires begins to rise. When the warmer air rises, it leaves a space. Cool air moves in to fill this space. But then there is a space where the cool air had been. So air from above moves in to fill this new space. In this way the air in the room begins to move in a big circle. When air moves in a circle like this we say that it circulates. When the air circulates, the warm air near the heater is carried to all parts of the room.

The air above the earth circulates, too. It begins to circulate when air near the ground is warmed by the sun. This makes the air rise. Cool air moves in to take the place of this warm air. The moving air near the ground makes surface winds.

While the air around the earth is moving in big circles, the earth is spinning all the time. The spinning of the earth turns the surface winds.

The picture shows the big circles of air in the atmosphere and the paths the surface winds follow.

Lesson II — Two Air Pollutants From Cars

Objective: Students will be able to discriminate between particulate and gaseous forms of air pollution in written form, to the satisfaction of the teacher.

Materials:

1 tank vacuum cleaner
1 rubber band
2 coffee filters
1 car
1 potted plant (a broad-leafed weed transplanted for this purpose)
1 transparent container (large enough to fit over the potted plant)

Introduction: Samples of automobile exhaust can be simply collected and used to show two types of air pollutants emitted from a standard combustion engine.

The particulate matter which will be seen in the vacuum collection activity are "small" pieces of unburned carbon. The finer the particles produced by fuel combustion in cars, the more likely they are to reach the innermost parts of the lungs where they cause the most damage. The large type of particulate matter is of minor concern compared to the overall problem of air pollution. It is, however, easier for children to see and its usefulness is in providing a concrete reference to the general topic of the car's contribution to the problem of air pollution.

Teaching about gaseous emissions from cars is complicated by the fact that the gas is invisible. Depending on the background and past learning experiences of the group, the concept of gas may have to be introduced or reviewed.

There are three types of gaseous emissions produced by cars: carbon monoxide, nitrogen oxide, and hydrocarbons. Carbon monoxide was chosen to focus upon because it is the air pollutant which currently represents the major health threat to Anchorage and Fairbanks residents. It is significant to the overall problems of air pollution because it accounts for more than 51% of the total annual air pollutant emissions in North America. This gas is almost entirely a human-caused pollutant. The most significant source is incomplete combustion, during which each carbon atom combines with only one atom of oxygen. Estimates show that automobile engines

alone contribute more than 80% of the global carbon monoxide emissions. (Andrews, William A. A Guide to the Study of Environmental Pollution, Prentice Hall, Inc. 1972.)

Vocabulary Preparation:

Particulate	carbon monoxide
particle	engine
exhaust	pollution
oxygen	atmosphere
gas	

Instructional Activities:

1. (first activity)

A) Cut a piece of filter paper a little bigger than the end of the vacuum hose. Fold it down and put the rubber band over the filter to hold it in place. Use this "pollutant collector" to collect the exhaust coming from an automobile. In doing this project be careful to stand to one side of the car so you will not breathe the carbon monoxide.

B) Ask, "What do you think we will find in our filter?"

C) After you have a good sample, discuss with the children the results of the collection. Does the sample have what they anticipated finding?

D) Ask, "Do these particles become part of the air? Is it possible that people can breathe these particles into their bodies? How do you think that these particles might cause damage to your lungs?"

2. (second activity)

A) Using a potted plant (broad-leafed weed transplanted for this purpose) review or introduce the fact that the plant needs oxygen to live.

B) Explain that you will now capture an invisible gas, called carbon monoxide, produced by cars.

C) Place the glass container over an exhaust pipe of a car to capture the car's emissions. Put the container over the potted plant. Use a piece of wood as a base to set the plant and jar on to stop the gas from leaking so that the plant can be moved to the classroom for observation.

D) The space in the jar is filled with a limited amount of oxygen and a large amount of exhaust fumes. The plant's leaves will drop slowly during the course of the day.

E) Ask the students to explain what has happened in terms of how the gas, captured from the car's engine, has affected the plant.

F) Develop the link between the plant's dependence on oxygen for survival and that of our own need for oxygen. Ask, "Can you explain what would happen to humans if they were to live in an atmosphere containing too much carbon monoxide?"

G) Ask the students to explain differences be-between particulate matter and carbon monoxide.

Lesson III — Health Effects of Carbon Monoxide and Particulates

Objective 1: Students will collect samples of dust in the air and in written form, to the satisfaction of teacher, will be able to produce a hypothesis of how the dust originated.

Materials:
- 3 five-inch index cards for each student
- 1 jar of vaseline
- 1 roll of masking tape
- several magnifying lenses

Introduction: The particulate matter found in Lesson II represents only one source of this type of air pollution. Before the health effects are introduced the students will extend their awareness of the variety of particulate air pollution.

Particulate matter includes such things as soot, mists, sprays, dust, dirt as well as many other chemical and mineral substances. In Fairbanks, Anchorage and much of Alaska, the greatest amount of particulates in the air are dust and dirt. The abundance of this form of air pollution is caused by transportation-related problems. The number of unpaved roads and the large number of automobiles send large amounts of dust and dirt into the air.

Health effects of this type of pollution are discussed under the second objective of this lesson.

Vocabulary Preparation:

particulate	particle
exhaust	atmosphere

Instructional Activities: This activity will take from three to five days to show a good result. It is begun by placing collection cards in various spots and concluded by observing the results several days later.

1. Each student should be given some cards with which to experiment. Lightly smear a very thin amount of vaseline over the central area of the index cards.

Lesson III **Health Effects of Carbon Monoxide and Particulates** (con't)

2. Cards should then be taped to various locations in the school as well as outside. Cards must be taped so that the vaseline faces outside which will enable particulate matter to stick to the greasy surface. Tape the cards to spots where they will not be easily torn down.

3. Collect the cards after several days and examine the results. There should be a variety of particulate matter stuck to the cards. If some do not, then pose the question to the class - what are the factors involved in the difference?

4. Ask, "What kinds of particles are on the cards? Are there any differences between the particles on your cards and the ones on the coffee filter in the last lesson?"

5. Ask, "Do you think that all particulates are from the same place? Where do you think the various kinds of particulates you found come from?"

6. Ask, "How do you think that these small particles could be a health hazard?"

Objective 2: Students will be able to complete perfectly a crossword puzzle of the major concepts involved in the lesson, following a class reading and discussion.

Materials:
2 reading and discussion sheets: "What is Air?" (pg. 40) and "Air Pollution Causes..." (pg. 41)
1 student response sheet: "Health Effects of Carbon Monoxide & Particulates" (pg. 42)

Introduction: The student reading and discussion material briefly covers the major health effects associated with carbon monoxide and particulate matter. The material is intended to link the pollutants discussed in Lesson II with real dangers to human health. The following information will provide you with detailed background information:

The effects of particulate air pollution on health are related to injury to the surface of the respiratory system, that is, to the linings of the lungs and throat. Such injury

Lesson III — Health Effects of Carbon Monoxide and Particulates (con't)

may be temporary, or permanent. It may be confined to the surface. However, by weakening resistance to infection, such pollutants may affect the entire body adversely. Chemicals carried into the lungs by particulates, for example, may cause cancer to develop on the lung lining, which then spreads throughout the body and proves fatal.

Carbon monoxide (CO), the second pollutant to be studied, is inhaled through the lungs and enters the blood stream by combining with hemoglobin, the substance that normally carries oxygen to the cells. CO combines with hemoglobin much more readily than oxygen does. The result is that the amount of oxygen getting to the tissues is drastically reduced in the presence of CO, and this can have a profound effect on our health. CO also impairs heart function by weakening the contractions of the heart which supply blood to the various parts of the body. The effect of this on a healthy person is to reduce significantly the ability to exercise, but in a patient with heart disease, who is unable to compensate for the decrease in oxygen, it can be a life-threatening situation. A person who has a heart attack in the presence of heavy carbon monoxide air pollution is more likely to die than if the attack had occurred in clean air. And carbon monoxide is also harmful to persons who have lung disease, anemia, or cerebral-vascular disease.

Carbon monoxide at relatively low concentrations can also affect mental function. Visual perception and alertness can be affected.

Vocabulary Preparation:

fatigue	asthma	heart disease
combustion	anemia	emphysema
suspended	smog	bronchitis
	cancer	respiratory

Instructional Activities:

Before the materials are passed out, review what the students have learned about particulates and carbon monoxide. They should be able to differentiate between the two by their physical characteristics and their possible points of origin.

1. Distribute student reading material. Have students read the material in a way that best suits the group.

2. Ask, "Why is clear air important to our lives?"

Lesson III — Health Effects of Carbon Monoxide and Particulates (con't)

3. Ask, "What health effects does carbon monoxide have on us? What health effects does particulate air pollution have on us?"

4. Ask, "Would you like to live in a city where the air is polluted? Does the city in which we live have polluted air?

5. Distribute the crossword puzzle. The answers to the questions are all to be found in the material which they have just read.

What is "AIR" ?

"AIR" is that thin band of mixed gases that covers the planet on which we live

Without "AIR" we could not exist. We need air to provide oxygen for our bloodstream to carry out the process necessary to keep us alive.

The average person BREATHES 35 lbs. of AIR each day - that is 6 times as much as the food and drink he consumes.

CARBON MONOXIDE

This poisonous gas from car exhaust drives out the oxygen in our bloodstream. A large amount can kill; a small amount can cause dizziness, headaches, and fatigue. It often exists in garages and heavy traffic, and is especially dangerous for people with heart disease, asthma, and anemia.

PARTICULATES

Particulates come from autos and building materials. Smoke, dust, fumes, etc., are the solid and liquid matter in air. They may settle to the ground or stay in the air. They soil clothes, dirty window sills, scatter light, and carry poisonous gases to lungs.

Air pollution may shorten your life!

With every breath you take of polluted air you risk developing a respiratory disease.

AIR POLLUTION CAUSES:

EMPHYSEMA

More than 20,000 Americans die annually of this disease. Emphysema causes a progressive breakdown of air sacs in the lungs, because of infection or irritation to the bronchial tubes.

• • • •

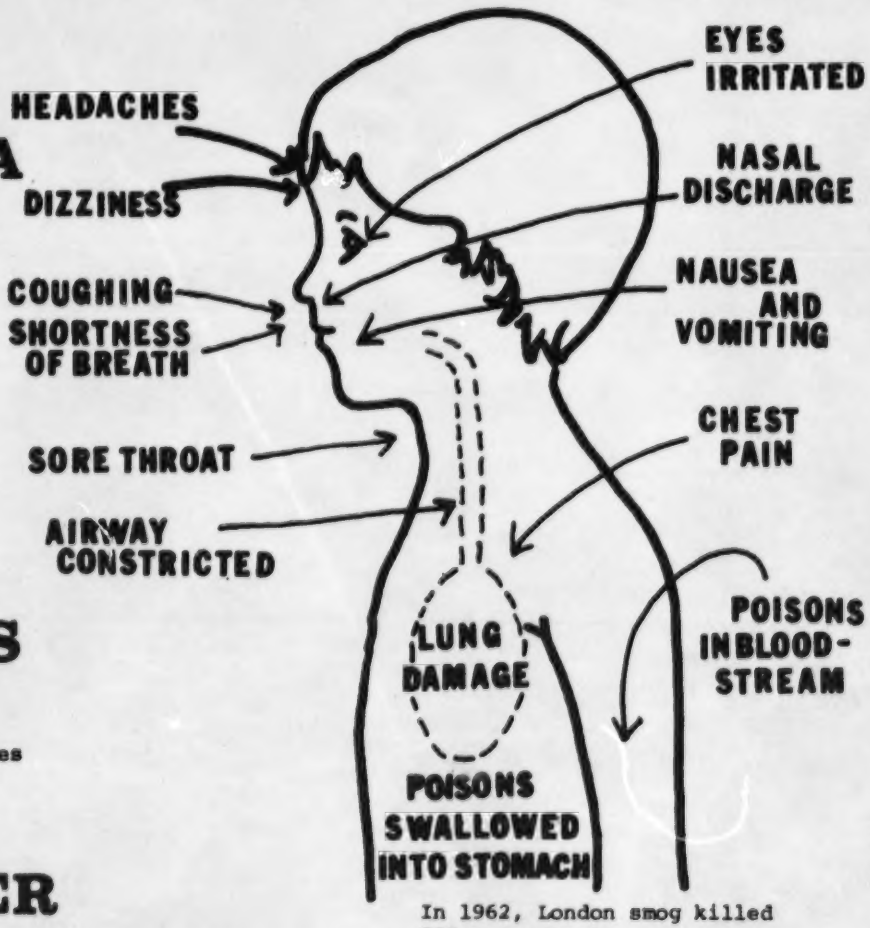
BRONCHITIS

Affects about 1 out of 5 men between 40 and 60. Chronic bronchitis contributes to early death.

LUNG CANCER

Is more often found in air-polluted cities. The relationship between polluted air and lung cancer has been proved by scientific experiments.

HERE ARE SOME SYMPTOMS:



some examples:

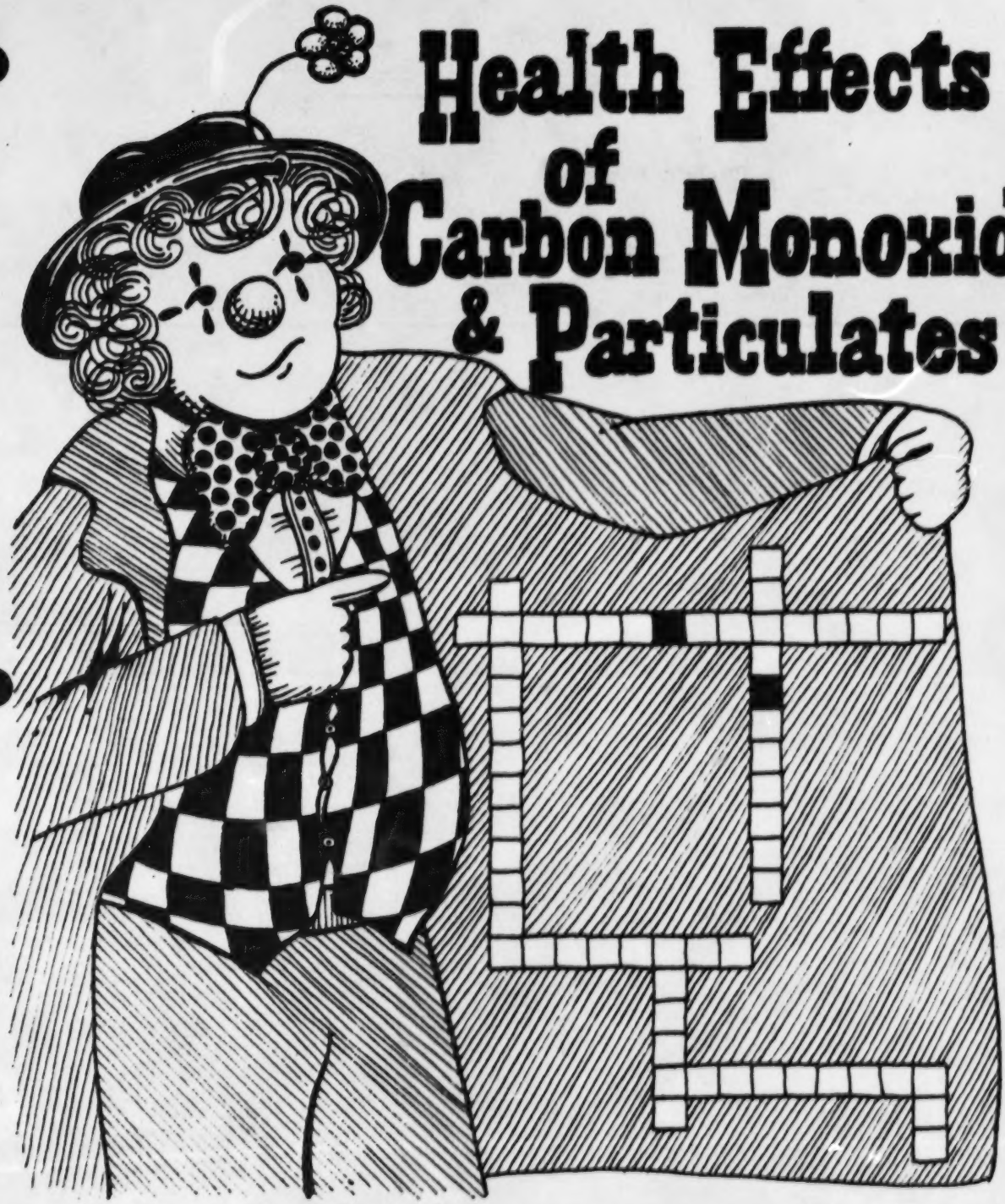
In New York, smog has caused more than 700 deaths over normal in the years 1953, 1963, and 1966.

In 1962, London smog killed 700 more people.

Air pollution killed 20 people in Donora, PA. -- 1948.

The 1952 London "KILLER FOG" killed 4,000 people in 4 days.

Health Effects of Carbon Monoxide & Particulates



DOWN
1. Smoke, dust, fumes, etc. are _____ in the air.
2. _____ _____ is found more often in air polluted cities.
3. Air provides this for our blood stream - _____.
4. The band of gases that cover earth - _____.

ACROSS
1. _____ _____ is a poisonous gas from car exhaust.
2. There are recognizable _____ of air pollution.
3. More than 20,000 people die annually of _____.

Answer Sheet:

Health Effects of Carbon Monoxide and Particulates

down 1. Particulates
2. Lung Cancer
3. Oxygen
4. Air

across 1. Carbon Monoxide
2. Symptoms
3. Emphysema

Lesson IV — How Weather Conditions Affect Air Pollution

Objective: Students will be able to answer all questions correctly on a student response sheet, following a reading and discussion on weather inversions.

Materials:
- 1 student reading material: Weather Inversion (pp. 46 & 47)
- 2 student response sheets: "How Weather Conditions Affect Air Pollution" (pp. 48 & 49)
- 1 visual aid (to be made into a transparency for an overhead projector or duplicated for individual student use): "Temperature Inversion" (pg. 51)

Introduction: Although the phenomenon of a weather inversion occurs naturally around the world, it is especially important to Alaskans and is of particular importance to residents of Fairbanks and Anchorage. Weather inversions, most usually, occur during the colder months. The danger involved in weather inversions happens because large amounts of air pollutants are concentrated into a comparatively small area.

The rate of pollution is highest in colder months due to heating needs and cold weather exhaust emissions from automobiles. A weather inversion can force the pollutants to lie in a thick mass close to the ground thereby increasing the amount of dangerous materials entering a person's lungs. An inversion is formed when temperature rises with elevation. Under normal conditions horizontal and vertical air movements (wind) disperse air contaminants. Inversions prevent vertical air motions and decrease atmospheric mixing. Dense, cool, surface air containing pollutants cannot rise through the less dense, warm air of an inversion, remaining "stagnant" beneath the inversion. The inversion "puts a lid on" the layer of air.

Vocabulary Preparation:

London	nightmare	crisis	sub-Arctic
England	ambulances	disaster	
fog	rescue	weather condition	
stationed	respiratory	elevations	

Lesson IV How Weather Conditions Affect Air Pollution (con't)

Instructional Activities:

1) Introduce the topic of the lesson through questions about which the lesson will provide information. Ask, "What time of year would you expect air pollution in the cities to be the worst? Why? Does anyone know what a weather inversion is?

2. If the students are familiar with the vocabulary words, distribute the reading material. Have the material read in a way that best suits the group.

3. The visual aid which is provided can be used as a transparency or duplicated to be handed out with the reading material. This should provide a visual reference for explaining the last two paragraphs of the reading material.

4. Ask, "What caused so many people to become sick and die? What was in the air that made it dangerous for people to breathe?

5. Ask, "Can you explain how a weather inversion happens? How does a weather inversion make normally polluted air more dangerous?

6. Ask, "Does anyone know if weather inversions happen in our city? How can we find out?

7. Distribute the response sheet. All answers to the questions are found in the student reading material.

Additional Activities: Write a story on how it would be to have lived in the London "killer fog".

Weather Inversion

The place is London, England, on a December day in 1952. A nurse coming off work at a hospital stepped into a street. She later told this story of what she saw.

"It was strange. I could hardly see where I was going the fog was so thick. There was something very strange going on. What first alarmed me was the smell. As the day went by, the fog grew much worse." London has always had thick fogs but this one was not chased away by the sun or the wind. The fog stayed for five days.

"By the third day, it was impossible to see. Cars could not be driven. People couldn't see a foot in front of them. Police were stationed all along the river to keep people from falling into the water. Even so hundreds of people fell in.

"The hospitals were a nightmare. They were full with sick people and still people kept coming. On emergency calls, ambulances were sent to help but never reached the people because they got lost in the deadly fog. Hundreds of people died. Newborn babies and people with respiratory problems were affected the worst."

What happened? Air pollution is generally a serious problem in the big cities. But what turned a serious problem into a crisis? Pollutants were trapped over the city by a weather inversion. After five days of this "killer fog" 4000 people had died.

Several things happened together to make this the worst pollution disaster ever recorded. A sudden cold spell and a weather

inversion were mainly responsible. What is this weather condition that scientists call a weather inversion and how does it affect our lives here in Alaska?

On a normal day, the temperature of the air is colder at higher elevations than the temperature nearer the land. This will make it possible for the wind to move the pollutants away from the city. An inversion happens when a stream of warm air moves in higher elevations. This makes the air near the land cooler than the air in the sky. The warm air traps the cooler air like a lid on a pan. Wind then is not able to move the pollutants away when this happens and the amount of air pollution in a city can become dangerous.

The weather inversions which occur in Alaska are among the strongest found anywhere in the world. Strong inversions are formed when the ground surface cools faster than the overlying air, common in the sub-Arctic winter when there is little sunlight to heat the ground surface. The long winter nights make inversion periods long. Dangerous amounts of air pollution may last for several weeks.

How Weather Conditions Affect Air Pollution

1. A _____ _____ can force pollutants to lie in a thick mass close to the ground.

2. During _____ months weather inversions are most likely to occur.

3. Usually air temperature is _____ at higher elevations than nearer the land.

4. An inversion happens when a stream of _____ air moves into the higher elevations.

5. Inversions are formed when the _____ _____ cools faster than the overlying air.

6. Long winter nights make inversion periods _____.

7. Weather inversions are dangerous because large amounts of air pollution are concentrated in a _____ area.

8. Normally _____ disperses air pollution.

9. The London "killer fog" was caused by a _____ cold spell and a weather inversion.

How Weather Conditions Affect Air Pollution

ANSWER SHEET:

How weather conditions affect air pollution

1. weather inversion
2. winter
3. colder
4. warm
5. ground surface
6. long
7. small
8. wind
9. sudden

TEMPERATURE INVERSION

Lesson V — How To Reduce Air Pollution

Objective: Students will be able to rate a list of responses which individuals and their families can do to reduce air pollution, according to how personally feasible they believe each to be.

Materials: 2 student response sheets:
"Solutions to Pollution" (pg. 54) and "Pollution Puzzle" (pg. 55)

Introduction: The intent of this lesson is to draw on the personal feelings and thoughts of the students to arrive at possible actions which students and their families can take to help reduce air pollution. Pollution problems have their roots in the actions and the choices of each individual. Students have been exposed to a few aspects of air pollution and to the potential health threats associated with specific pollutants. Students are expected, in this lesson, to develop their awareness of their relationship to the environment.

Vocabulary Preparation: column reduce describe

Instructional Activities:

1. Review the major concepts discussed in this unit: air pollution, carbon monoxide, particulates, health problems, and weather inversions. (Students should understand that air pollution is composed of identifiable parts, it causes ill health, and certain natural weather conditions intensify the problem.)

2. Ask, "Do you think that people are responsible for air pollution? How? Why?"

3. Ask, "How can people reduce air pollution? What kinds of things can you or your family do to reduce air pollution?" (Some starters are: stop smoking, walk short distances instead of driving, don't burn rubbish, bury garbage instead of burning, drive non-polluting cars, ask government for help, etc.)

4. Make a list of the student responses on the chalkboard.

5. Distribute the response sheet. Direct the students to copy each response from the chalkboard and to place them under the columns on the response sheet which they feel each should be placed.

Additional Activities:

1. Using the student responses, survey the class as to their rating of the various ways to reduce air pollution. Make a poster of this information or use the information to plan a bulletin board display.

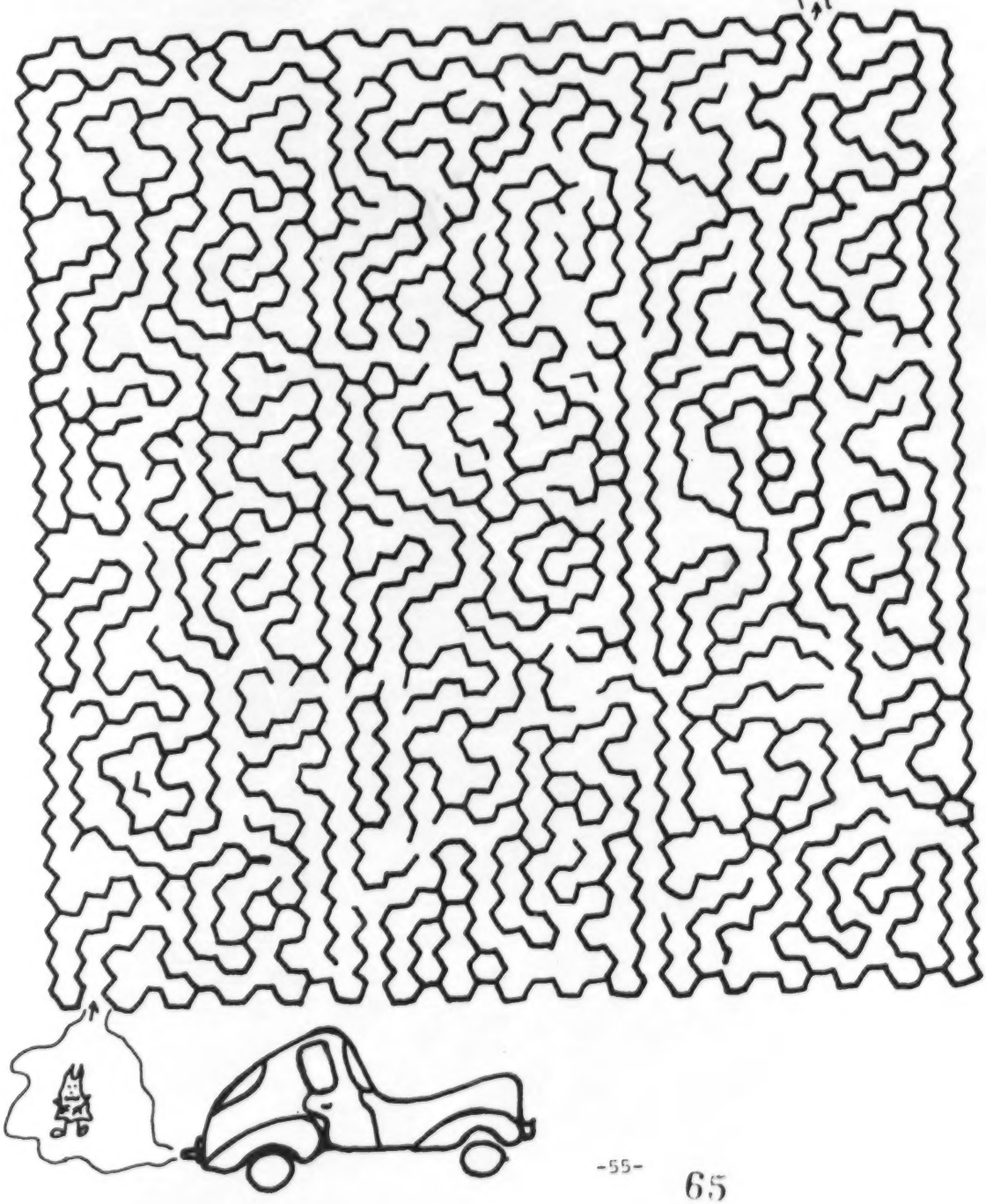
2. Use the student puzzle sheet to reinforce the idea that air pollutants may enter the human body through breathing.

3. Compare sources of energy with sources of air pollution. Relate energy consumption to air pollution. See if the list of activities to reduce pollution can be enlarged.

SOLUTIONS TO POLLUTION

CANNOT DO	SOMETIMES CAN DO	WILL DO

FOLLOW the POLLUTANT into your LUNGS



CURRICULUM FEEDBACK FORM

Unit used_____ Grade Level _____ Name_____

Age Level_____ # of Children_____ Address_____

Type of Group (school class, scouts, etc.)

_____

Approx. hours spent on unit_____

Comments_____

_____

_____

_____

1. Background information was: Just what I needed I needed more unnecessary
2. How many follow-through suggestions were used?
3. Instructions were easy to follow? yes___ no___
4. Children were interested? ___ ___
5. Suggested discussion questions worked well? ___ ___
6. I will use this unit again ___ ___
7. I used other grade-level units to supplement the one for my group's age ___ ___

Please describe below any adaptations you made or improvements you suggest:

Please mail this form to the address listed on the back, and THANK YOU VERY MUCH FOR YOUR HELP!

fold

(Stamp)

Information Office
Alaska Department of Environmental
Conservation
Pouch O
Juneau, Alaska 99811